Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

## ART. VIII. — *The Geological Evidences of the Antiquity of Man, with remarks on Theories of the Origin of Species by Variation.* By SIR CHARLES LYELL, F. R. S., Author of "Principles of Geology," "Elements of Geology," etc., etc. Philadelphia: George W. Childs. 1863. 8vo. pp. 518.

THE writings of Sir Charles Lyell have always been favorably received upon this side of the Atlantic. Scarcely any geological treatise is better known than his elementary works on Geology. Besides the clearness with which principles are elucidated and phenomena described, his great power of generalization and his capacity of readily discriminating between worthless and valuable points in scientific argument have made his works entertaining and permanently useful. The same qualities can be discerned in his latest book, in which one particular topic of historico-geological research is treated of with great candor, comprehensiveness, and thoroughness, almost every branch of natural science being made to contribute its quota of aid to sustain some portion of the argument.

Lyell has always been foremost in the investigation of the geology of the later formations, and the terms in common use among scientific men to designate them are of his invention. Thirty years ago he proposed to call the oldest of the Tertiary series the *Eocene*, because in it is a very meagre proportion of the remains of molluscous animals identical with those now living, — the *dawn* of the existence of the *recent* systems of life; next came the *Miocene*, the *less recent*, or those strata containing a minor proportion of existing molluscous forms; and, thirdly, these were the strata containing a still greater proportion of living species, the *Pliocene*, the *more recent.* These three groups embrace all the Tertiary rocks. He now proposes to divide the Alluvium or Quaternary into two periods; — the *Post Pliocene*, or those strata containing the forms of life which flourished during the earlier portion of Quaternary time; and the *Recent*, or those strata in which the species found fossil are entirely identical with living animals. In the Eocene the percentage of living mollusks is from 2 to 3; in the Miocene, from 15 to 20; in the Pliocene, from 40 to 70; and in the Post Pliocene, from 90 to 95. The grand distinction between the *Post Pliocene* and the *Recent* formations consists in the presence of extinct species in the former, while both contain the remains of man. The glacial or ice period of all high northern and southern latitudes is referred to the early part of the Post Pliocene.

Lyell's classification of the Tertiary rocks has been generally adopted both by English and American geologists; whether the proposed nomenclature of the Alluvial period will be as extensively accepted remains to be seen. A more natural division, at least in high latitudes, is the common one of the Glacial or Drift period and the Alluvium proper; or of unmodified and modified Drift. The gigantic icebergs and glaciers which have rounded our mountains and ploughed out our lake-basins are not conceived of under the mild epithet of Post Pliocene; whereas such a prominent feature in American and European history should, if possible, be alluded to in the name. Lyell's division is very unequal, too, so far as decades and centuries are concerned. A few thousand years express the duration of the Recent period, while for a just conception of the Post Pliocene the place of the decade must be supplied by the millennium. The term Recent would be more appropriate as a subdivision of the later Alluvial period, such as that which divides modified Drift or Alluvium proper into three parts; namely, the Beach period, when the American continent was largely submerged, and the waves formed beaches upon the higher hills and mountains; the Terrace or Champlain period, when the greater part of the terraces upon our rivers were in the process of formation, and the waters of the coast were abundantly tenanted by mollusks, whose remains are now found at an elevation of five hundred feet above tide-water along the present sea margin and such inland waters as Lake Champlain and the St. Lawrence and Hudson Rivers; and, thirdly, the Historic period, embracing the whole time of man's existence upon the earth. The term Recent, as now used, is a subdivision of the term Historic in the more elaborate classification.

Many persons are unnecessarily startled by the announcement of the discovery of fossil men. They have insensibly misconceived the meaning of the term fossil. Having heard of fossil saurians of extinct types, of coal-plants, of sauroid fishes and trilobites, they have fancied that whatever has been fossilized must have existed hundreds of thousands of years ago. The march of time, however, is constantly burying in the earth by purely natural causes the calcareous shells of mollusks, the bones of mammals, and the works of man. Employing the strict meaning of the word, we may say that the bones of the domesticated animals swept away by a freshet in 1850, and covered up by detritus at the mouth of the Potomac, are genuine fossils when dug up in 1860 during a summer's drouth. So, too, the mould of a shell, or the impression of a feather or a foot in clay, is a fossil, and is always recognized as such when the soft mud has become hardened into shales and sandstones. In a New England cabinet the visitor may see the print of a human foot upon clay, unwittingly left upon the soft mud in 1852 in the same layer with the prints of gallinaceous birds. Yet it is a fossil just as much as the numerous ichnites of birds and reptiles of the Mesozoic age by its side. So the numerous stone-hatchets and arrow-heads of Indian manufacture ploughed out of the soil every spring by our farmers may be considered as fossils, — scanty remains of a tribe of men now extinct over the greater portion of the Eastern States. The buried cities of Herculaneum and Pompeii, the human skeletons from the Guadaloupe limestone in the London and Paris collections, and the silver coins in the ferruginous conglomerate from Tutbury in England, are fossils, as much as the encrinal heads and trilobitic shields of the Silurian system. The definition of a fossil, therefore, is the body, or any known part or trace, of an animal or plant buried by natural causes in the earth, whether in the Silurian age or in the year 1860.

While one class of writers have been startled by the thought of the possibility of the existence of fossil men, another class have seized upon every human relic found in an ambiguous position, as proof that man has lived upon the earth for many thousand years. This conclusion is jumped at with great eagerness; but of the many examples adduced anterior to the present discussion, not one has been proved, when thoroughly investigated, to antedate the Biblical Adam. Hence, upon one taking up the discussion anew, like Lyell, there rests an *onus probandi*, although it be clearly shown that man's remains are associated with those of extinct quadrupeds. The numerous details given respecting the modes of occurrence of human remains cannot fail to present us with corrected views of the connection in time between man and different races of animals, as well as to display the highly interesting relations of geology to archæology. To use a zoölogical phrase, they will supply the " connecting link " between these two sciences.

Without specifying any examples of human fossils already pronounced upon, we will proceed to notice those referred by Lyell to the " Recent period," whose comparatively recent origin is admitted. Very interesting examples are found in Denmark, both in the peat-bogs and the shell-mounds or " Kjökkenmödding." The Danish antiquaries have been at work upon these relics for many years, and have inferred the existence of several periods from the different sorts of implements found at various levels. They trace evidence of the existence of three different periods previous to the time of authentic history. First, *a stone period*, in which the inhabitants were brachycephalous, or with short heads and small bodies, like the modern Laplanders, and used implements manufactured chiefly from stone, never from metals. During this period the Scotch fir (*Pinus sylvestris*) predominated in the forests. Second, *a bronze period*, in which the inhabitants were larger than in the stone age, and used many implements of bronze (an alloy of copper and tin) in addition to those made of stone. The forests in this period were chiefly composed of the oak (*Quercus robur*). Third, *an iron period*, in which implements manufactured from iron superseded those of stone and bronze, and the forests were largely occupied by the beech-tree (*Fagus sylvatica*). This period is synchronous with the early traditional and written history of Denmark. We also live in the iron age, when this indispensable metal is applied to thousands of important uses by the agriculturist and mechanic.

The peat deposits of Denmark have been accumulated in the hollows of the older Alluvium, and vary in thickness from ten to thirty feet. The lowest stratum, of two or three feet in thickness, is entirely composed of the sphagnous peat, above which are layers made up of marsh-plants, shrubs, and trees of various kinds in addition. The Scotch fir is not now known to exist in Denmark, but the oak still flourishes, though scarce, while the beech is very common. These different trees are found at successively lower levels in the peat. The shell mounds are refuse heaps, where the shells of the oyster, cockle, and other edible mollusks are thrown, together with the bones of mammals, birds, and fishes, which had served for food, and various other species of rubbish. Similar heaps are scattered along our own Atlantic coast from Prince Edward's Island to Georgia. In both continents these heaps indicate that the oyster formerly flourished in abundance where it is now extremely scarce; as in the brackish waters of the Baltic Sea, and on the coast of Maine. This fact, however, does not necessitate a very ancient date for the accumulation of the rubbish-heaps, since in Maine we can prove that the oyster became thus nearly extinct within the time of the white population.

In the Denmark heaps are found the remains of such living mammals as the dog, deer, and seal. The bones of the wild bull (*Bos urus*, Linn.), living in the time of Julius Cæsar, occur in immense numbers, as do those of the more recently extinct auk (*Alca impennis*). But no remains have yet been found in them of the woolly rhinoceros, mammoth, or mastodon. The implements preserved are altogether of stone, and hence belong to the stone age. The argument that these remains are more recent than those of the stone age elsewhere, as in the valley of the Somme, is purely a negative one. The Post Pliocene animals may not have been so common in one place as another. The Danes have endeavored to estimate by the thickness of the peat-beds, and the succession of the fir, oak, and beech in the forests, the number of years since the beginning of the stone period. The beech flourished in Denmark at the time of the Roman ascendency, and does now, making a period of eighteen centuries. Estimating the duration of each variety of forest at two thousand years, they have calculated the total length of these periods to be six thousand years. The shell mounds do not afford trustworthy data for calculation.

We cannot avoid allusion to facts respecting the growth of peat and of forest-trees, which do not seem to have entered sufficiently into the basis of the Danish calculations. The growth of peat is extremely variable, even in contiguous swamps. It accumulates much more rapidly in the primitive forest, than after clearings have been effected; chiefly, perhaps, because in a wooded country rain is more common, as any one who has travelled in a wild northern region cannot have failed to notice. When aided by obstructions, such as a windfall or a beaver-dam, its growth progresses rapidly; but when drainage has been established, and the trees removed, it forms very slowly. The basis of the calculation is founded upon the rate of growth when much of the country has been cleared, and must manifestly be much too small to indicate the amount of peat deposited in the bronze and stone ages.

In relation to the rapidity of the succession of trees in forests, we can judge better in America than in Europe, because the primitive forest still flourishes with us in many localities, and we can also examine several centuries of the subsequent growth. The original Danish forest of Scotch fir may have been destroyed by fire in a single season, as is often the case in North America. The great blackened trunks would have remained as monuments of the calamity for half a century, when they would have been replaced essentially by the "second growth," which, with us, consists of birch, poplar, and similar trees. In two or three centuries, the new forest would have become thoroughly established, but for the most part composed of different trees from our second growth. In Denmark, the second forest seems to have been of oak, which must have flourished for a long period, and, if not destroyed by human agency, could be replaced only by another variety of tree, better adapted to the soil and climate. The draft of the substances from the soil fitted for the sustenance of one particular kind of tree would, in the course of centuries, leave some other inorganic element predominant, better suited for the growth of some other tree. In Denmark, oaks were apparently succeeded by beeches, both of which extend themselves very slowly. But it does not agree with our observations to expect that the whole forest would have been made up exclusively of either firs, oaks, or beeches. Our primitive forests commonly contain a "mixed growth": it is generally very limited valleys or hill-tops that are covered by only one kind of tree. Pine, spruce, juniper, and maple are intermixed in equal proportions in some regions, while oak, hickory, and chestnut predominate elsewhere. Observation would therefore indicate the probability of a mixed growth in the stone and the bronze, as well as in the iron age. For this reason, we must leave a margin in our calculations of time from the succession of forests; certain districts having the oaks predominating longer than others, may have been those taken for the calculation. Estimating from these new stand-points, we may say that the minimum time required to produce the changes observed in the Danish forests may be two thousand years, and the maximum that assumed by the antiquaries as the mean. The medium between the natural extremes will therefore reduce the assumed sum by one or two thousand years.

Another interesting class of remains described by Lyell are the ancient Swiss Lake Dwellings, built upon piles. About ten years ago, during a very dry season, the citizens of Meilen, on the Lake of Zurich, resolved to add to their landed possessions by dredging mud from one portion of the bottom of the lake, and accumulating the alluvium so abundantly in the shallower regions that a meadow should be formed. During these dredging operations, they found many piles driven deeply into the mud, together with numerous articles of domestic use, such as hammers, axes, celts, fragments of pottery, charred wood, and bones. Subsequent researches by archæologists in Western and Central Switzerland, where these lake dwellings were chiefly situated, brought to light bronze implements, arrow-heads, fishing-gear, canoes, — not of birch-bark, but hollowed out of logs, — ornaments, amber, remains of wheat, barley, apples, pears, plums, raspberries, hazel-nuts, beechnuts, and even iron instruments, and bronze and silver coins of Greek manufacture. The animal remains found were such as the following: twenty-four species of wild mammals, besides several domesticated mammals, eighteen species of birds, three of reptiles, and nine of fresh-water fish. All these fifty-four species are now living in Europe, except the wild bull, *Bos primigenius.* They were such animals as the bear, badger, polecat, ermine, weasel, fox, hare, beaver, stag, deer, elk, chamois, and the aurochs, or Lithuanian bison. Many of their bones had been split by some sharp instrument, as if to obtain the marrow. Skulls of men have been found sparingly among the earliest of these remains, which do not differ perceptibly from those of the Swiss of the present day.

The earliest known notice of lake dwellings is given by Herodotus, of the Pæonians, a Thracian tribe, who used these habitations about 520 B. C. At the present day the Papoos, in New Guinea, construct similar dwellings. The latest period to which the Swiss examples are referred is the sixth century of our era; but Keller says that so late as the last century there were several fishing-huts constructed upon the same plan on the river Limmat, near Zurich. The published descriptions of the modern lake dwellings have furnished archæologists with abundant material from which to restore the ancient villages of the Swiss. Their habitations were like modern warehouses, built on wharves resting upon piles near the shore, in shallow water, and connected with the land by narrow and slender platforms. Many of the buildings were circular. It is believed that no less than three hundred wooden huts were sometimes comprised in a settlement which must have contained at least a thousand inhabitants.

The age of the oldest relic of the stone age in Switzerland has been calculated, from the thickness of the delta of the Tinière, a tributary torrent of the Lake of Geneva, to be from five to seven thousand years. Similar results flow from a calculation of the time required to produce morasses, which in some localities have been filled up between an ancient shore and the dwellings. Numerous evidences of lake dwellings have been recently discovered and partially explored in Ireland.

Other remains of the Recent Period noticed are the Egyptian relics in the valley of the Nile, the ancient mounds of the Mississippi valley, and remains dug out of the Florida coral reefs. The trustworthiness of the calculation of the time required for the deposition of the Nile mud may be learned by comparison with archæological monuments and the writings of the earliest historians. According to the most recent conclusions of Egyptologists, the oldest of the monuments were erected not long after the epoch of the Noachian Deluge. But

Bunsen ascribes the age of Menes, the first Egyptian king, to 3643 B. C., and Lepsius to 3893 B. C., or, at the most, about six hundred years earlier than the era of the Deluge, according to the Septuagint version. No one will for a moment pretend that the age of man in Egypt is essentially greater than that assigned by Lepsius to the first of the mortal kings. The geological calculations of the age of bricks dug from the depth of sixty and seventy-two feet, made in good faith upon the uniformitarian theory, assign to them respectively an antiquity of 12,000 and 30,000 years, or from 5,000 to 23,000 years in excess of the maximum estimate made by Egyptologists. The natural conclusion from this discrepancy agrees with that of many eminent geologists years ago, that the data relied upon for the geological calculations are not worthy of reliance. And if this be true in regard to the calculation of time from the thickness of alluvial deposits in Egypt, may there not be a similar error in calculations based upon corresponding data elsewhere? Without anticipating the discussion of this branch of our subject, we will simply say now, that, by granting the average per cent of error in the Egyptian examples to be the correct discount for all other cases of like nature, the figures would sometimes become wonderfully reduced.

The remains of man in the basin of the Mississippi are but briefly described, — only so far as to show that the builders of the mounds belonged to the bronze (copper) age, and may have belonged to a different race from the later copper-colored Indians of the Eastern States, — probably to the same with the ancient Mexicans. The calculations of the age of the mounds rest upon the age of the trees growing upon them, and the supposition that these trees had been preceded by others. No very great antiquity has thus been attained. Too much reliance has been placed upon the stories of the great age of the Indian skeleton excavated from under the Gas-Works at New Orleans, at a depth of sixteen feet, and beneath four cypress forests, and, according to Doctor Dowler, having an age of 57,600 years; — also, on the great antiquity — 10,000 years — of the human remains found by Count Pourtalis in the Florida coral reefs. Lyell places little confidence in these cases, while few American geologists regard them even as highly as he does.

A very valuable fact is communicated by Sir Charles, near the close of his remarks upon the Recent Period. Upon the best of evidence, the proof is accumulated that upon both the eastern and western coasts of Scotland there has been an elevation of the land from twenty-five to twenty-seven feet during the past seventeen centuries. The evidence consists partly in the elevated position of the wall of Antoninus, and of ancient Roman harbors above tide-water, and partly in the existence of a raised sea-beach along both shores. These facts throw light upon the age of the buried canoes dug up in the streets of Glasgow, and the numerous other works of art found in that vicinity, which would have been by the antiquary referred to a much older epoch had we not irrefragable evidence that this region was under water as late as the time of the Roman occupation. The supposition of similar changes of level in other European countries where human relics have been discovered would illumine many obscurities; and as the coast-levels are constantly changing, those who assign an enormous antiquity to man's existence on the earth have the greater difficulty in maintaining their position.

Passing next to the discussion of the human remains found buried in connection with the bones of the extinct animals of the Post Pliocene period, we find the most important portion of the treatise. Remains of men are found associated with those of extinct bears, elephants, and other animals, in caverns, alluvial gravel, and the *loess* or silt of the Rhine. Each of these classes of deposits deserves separate consideration.

Until very recently, it was commonly supposed that the intermixture of human remains with those of extinct animals in caves was produced accidentally, the dens of the animals having been selected by man as places of sepulture. Doctor Buckland, thirty years ago, illustrated this view in his great work entitled *Reliquiæ Diluvianæ;* and the bone-caverns described by him are commonly admitted to have been thus used. In such cases it is not strange to find the bones intermingled. A good example of the intermixture of these classes of remains by natural causes is found near Liége in Belgium. Their investigation was undertaken by Doctor Schmerling more than thirty years ago, and his conclusions agree with those now adopted by Lyell, although the latter did not formerly accept them. The rock in which these caves occur is the mountain limestone. Where the caverns are not too small, beautiful sections of the strata of limestone, from two to three hundred feet in height, are exposed. Most of the materials in them appear to have been washed in through narrow fissures, whose upper extremities are covered with soil and gravel, so as to be scarcely discernible. One of these fissures near Magnée has been filled to the very top with sand, mud, angular and rounded stones, besides bones of the cave-bear. Several small chasms branch off from the main duct, which are also filled to the brim in a similar manner. These fissures are not perpendicular, but inclined from thirty to forty degrees, having the sides incrusted by stalagmite, which has sometimes been broken off and mixed with the introduced detritus. The whole has been consolidated into conglomerate by means of water charged with carbonate of lime percolating through the mass. This reagent preserves the bones. Carbonic acid is evolved by the action of rain-water upon the humus, or decaying mould of the soil. The water charged with the gas permeates the limestone, dissolves a large proportion of it, and afterwards, when the excess of acid has escaped, the carbonate of lime is deposited in the form of stalactite and stalagmite. But this process is subordinate to the pouring in of the fragments, which must have been effected by streams of water, such as are common in all limestone countries, and may have been caused by earthquakes, or by changes in the course of rivers upon the surface.

Lyell quotes examples of subterranean rivers in the vicinity, to show that it is legitimate to call in their agency to explain the phenomena. Such streams are often torrents, and at their entrance into the rock are heavily charged with sand, mud, snail-shells, and pebbles, but where they emerge are as clear as any spring-water. No less than forty of these caverns have been explored by Schmerling near Liége. Some of them contain two regular layers of stalagmite, separated by *cave mud*, or the slowly accumulating deposit of fine particles in the bottom of an excavation, induced chiefly by organic agencies. This indicates a diversion in the current for a while, and then its return to the old channel, caused, perhaps, by the choking up of the second course by detritus. The bones in these caves have generally been rounded, some of them very much so, showing that they had been subjected to abrasion for some time, and that they might have been transported a great distance. Other bones are preserved in their natural relations, so as to make it probable that they were introduced into the crevices when covered with flesh. The bones of the extinct animals found are those of the cave-bear, hyena, elephant, and woolly rhinoceros. Scattered among them indiscriminately are the bones of a multitude of living animals, far more numerous than the extinct ones, such as the wild-cat, beaver, wild boar, roe-deer, wolf, hedgehog, red deer, fox, weasel, hare, rabbit, mole, dormouse, water-rat, shrew, and others. The bones of man occur sparingly, but flint implements frequently, with a few manufactured from bones. There can be no doubt in any mind that the bones of these extinct and living animals were introduced into the Belgian caves simultaneously, and it is highly probable that we have proof here of the contemporaneousness of man and the other living animals with some now extinct. The only doubt is whether the bones of the extinct animals may not have been washed out of an older deposit, and been re-deposited in company with the bones of later species. It is by no means uncommon in the older formations to find early fossils in company with later forms, and occasionally it is difficult to distinguish between the imported and the native varieties.

No estimate of the antiquity of the Liége skeletons is given; but two reasons for a great antiquity are suggested: the first, that sufficient time must have elapsed for the extinction of the earlier species; the second, that the configuration of the country must have changed considerably since the streams of water were enabled to pour their contents into fissures many feet — in one case two hundred feet — higher than their present level. It should be remembered, however, that the large assemblage of the Eifel volcanic craters and cones is only sixty miles distant from these caverns, and that they were active very recently. A few earthquake shocks would in a very short time produce changes of level not ordinarily effected by secular variations in many thousand years.

A few human skulls of great interest have been taken from the caverns near Liége, which are made the subject of a special chapter, as also of much attention from Professor Huxley, in his late work on " The Place of Man in Nature." The oldest one came from Engis, being associated with bones of the extinct elephant, rhinoceros, cave-bear, and tiger, on the one hand, and on the other with more numerous remains of such living animals as the bear, stag, wolf, fox, and beaver. It does not belong to the highest type of the enlightened Caucasian, but agrees well with the skulls of the more uncultivated members of the race, or, in other words, with what we should imagine the Caucasian to be if reduced to a savage state, like the modern Australians, with whom the former owner of the skull is compared. Huxley is an ardent advocate of the Darwinian hypothesis, but yet writes as follows concerning this example: " The question whether the Engis skull has rather the character of one of the high races, or of one of the lower, has been much disputed ; but the measurements of an English skull, noted in the catalogue of the Hunterian Museum as typically Caucasian, will serve to show that both sides may be right, and that cranial measurements alone afford no safe indication of race."

The skull from Neanderthal has " no such decided claims to antiquity " as the Engis example, and yet it belonged to a more brutal specimen of humanity. No other bones were found in connection with it. It resembles the skull of an ape more than is usual, " not only in the prodigious development of the superciliary prominences and the forward extension of the orbits, but still more in the depressed form of the brain-case, in the straightness of the squamosal suture, and in the complete retreat of the occiput forward and upward from the superior occipital ridges." But its cranial capacity, from which so much has been claimed by the development school, falls entirely within the limits even of the English skull, the greatest observed capacity of which is 114 cubic inches, and the smallest 55, while the minimum capacity of the Neanderthal specimen is estimated at 75 inches. Some Hindoo skulls have a capacity of 46 cubic inches, and the very highest capacity of the gorilla is 34.5 cubic inches.

The conclusion is, that these skulls are decidedly human, and do not form a connecting link between man and the apes. Two paragraphs from Huxley will be appropriate in this connection.

> "The marked resemblances between the ancient skulls and their modern Australian analogues, however, have a profound interest, when it is recollected that the stone axe is as much the weapon and the implement of the modern as of the ancient savage; that the former turns the bones of the kangaroo and of the emu to the same account as the latter did the bones of the deer and the urus; that the Australian heaps up the shells of devoured shell-fish in mounds, which represent the 'refuse-heaps,' or 'Kjökkenmöddings,' of Denmark; and, finally, that, on the other side of Torres Straits, a race akin to the Australians are among the few people who now build their houses on pile-works, like those of the ancient Swiss lakes."
>
> "Finally, the comparatively large cranial capacity of the Neanderthal skull, overlaid though it may be by pithecoid bony walls, and the completely human proportions of the accompanying limb-bones, together with the very fair development of the Engis skull, clearly indicate that the first traces of the primordial stock whence man has proceeded need no longer be sought, by those who entertain any form of the doctrine of progressive development, in the newest tertiaries; but that they may be looked for in an epoch more distant from the age of the *Elephas primigenius* than that is from us."

The conclusion, then, to which even the advocates of the great antiquity of man, and his origin from the apes, are forced, in regard to the character of the most ape-like skulls of man yet discovered in all the caverns, in no respect militates against the commonly received opinion of man's origin directly from the hands of God by creation, as a being superior to and unlike the highest ape. Even if it could be proved that man existed ten thousand years ago, his physical structure did not vary essentially from its present configuration.

The most interesting and carefully explored of these caves in England is at Brixham in Devonshire. Its exploration was conducted under the auspices of the Royal Society and the superintendence of Mr. Pengelly. It was a new cave, never before explored. Its discovery was accidental, on account of the falling in of the roof. The north and south passages in this set of openings are "fissures connected with the vertical dislocation of the rocks"; but the east and west passages are tunnels, apparently hollowed out by water to a great extent. The stalagmite is confined to the north and south passages. Five galleries have been excavated, whose united length amounts to several hundred feet. Their width never exceeds eight feet. Some of the openings were entirely filled with detritus. The following is a general statement of the order of the deposits in these openings: —

> " 1st. At the top, a layer of stalagmite varying in thickness from one to fifteen inches, which sometimes contained bones, such as the perfect antler of a reindeer, and an entire humerus of the cave-bear.
>
> " 2dly. Next below, loam or bone-earth, of an ochreous red color, from one foot to fifteen feet in thickness.
>
> " 3dly. At the bottom of all, gravel, with many rounded pebbles in it, probed in some places to the depth of twenty feet without its being pierced through, and, as it was barren of fossils, left for the most part unremoved."

The bones derived from this cave are those of the mammoth, rhinoceros, cave-bear, hyena, cave-lion, reindeer, horse, ox, some rodents, and others not determined, but chiefly extinct species. No human bones were anywhere found, but many flint knives of human manufacture were obtained, chiefly from the bone-earth. Fifteen good specimens in all were obtained, one of them thirteen feet from the surface. The clearest case of the coincidence of the time of the deposit of the knives and the bones was where a very perfect tool was found in close proximity to the entire left hind-leg of a cave-bear. Every bone of this leg was in its proper place, even to the patella and astragalus. It must have been introduced when covered with flesh, or at the farthest when its constituent bones were bound together by the natural ligaments. The introduction, therefore, of the entire leg of the extinct bear with the flint tool, in Lyell's opinion, is a very clear proof that man and the cave-bear were contemporaneous. This is certainly the best proved example we have thus far seen of the contemporaneousness of man with the Post Pliocene animals. The cavern was probably filled as the Belgian caves were. No attempt is made to compute the chronological age of the inhabitants of the Brixham cave. None of the bones, either in the Belgian or the English caves described by Lyell, appear to have been gnawed by carnivorous animals after their deposit.

Other caves containing relics of man and of extinct animals, which are of great interest, are fully described by Lyell. One is in Somersetshire, containing flint implements like those at Amiens, with remains of both extinct and living mammals. Another, in South Wales, contains teeth of the hippopotamus, besides an immense number of the antlers of reindeer, and flint knives. Two caves in North Sicily yielded flint knives, bits of charcoal, burnt clay, and land shells, in connection with remains of the African hippopotamus and elephant. Lyell suggests that Sicily may have been united to Africa within the human period, partly because changes of level are common about the Mediterranean, many examples of which have been previously described by him, partly because an elevation of three hundred feet would connect Sicily and Africa by land, and partly because the presence of the African mammals in Sicily suggests the connection.

Only one other important cave remains to be noticed, — an ancient burial-place of the primitive inhabitants at Aurignac, in the South of France. The account of it was derived from the writings of M. Lartet. In 1852 a laborer pursued a rabbit into his burrow on the steep hillside. He put his arm into the hole, and to his great astonishment drew out one of the long bones of a human skeleton. His curiosity excited, he dug away the talus, and discovered a cave, whose mouth was closed by a large slab of rock. Having removed the door, he found seventeen human skeletons, which had been buried apparently in a sitting posture. Astonished to hear of the occurrence of so many human relics in so lonely a place, the people of Aurignac flocked to the spot, and the Mayor ordered the bones to be removed and reinterred in the parish cemetery. Several years afterward, Lartet explored this burial-place, and found outside the vault a layer of ashes and charcoal, containing many human implements of stone and bone, and also the broken and gnawed bones of both extinct and living animals. Without doubt the ashes mark the occurrence of burial feasts, so common among the early Europeans. The bones of herbivorous animals outside the vault were the most numerous; and the bones and coprolites of hyenas being mingled abundantly with them led to the inference that the hyenas used the herbivorous animals for food, devouring them at this favorite place of resort. Seventeen species of mammals were found outside, and only three within the vault, — the cave-bear, the lion, and the pig. Among those without are the remains of the elephant, rhinoceros, horse, Irish stag, reindeer, aurochs, wild-cat, hyena, brown bear, badger, wolf, and fox, — chiefly extinct animals. The remains within were less injured than those without; but they all lay in the earth beneath the human relics.

Without further description of this interesting burial-vault, we must give it as our opinion that none of these phenomena forbid the supposition that the cave was originally inhabited by the extinct carnivorous animals as a den and feeding-place, into which they dragged their prey; and that at a subsequent period the inhabitants of the vicinity cleared out a portion of the rubbish so accumulated, and then used it as a place of sepulture, there cooking and eating their rude feasts, and breaking up the bones for ornaments at the door of the sepulchre. Every fact stated by Lartet can be thus explained, and hence, without further details of a different character, the relics of this cavern cannot be used legitimately to prove the contemporaneity of man with the fauna of the Post Pliocene period. It becomes us not to give in our adhesion to any uncertain evidence respecting the coexistence of any recent and extinct animals.

Two widely separated instances of human fossils deserve notice in this connection. One is the "fossil man of Denise," comprising the remains of more than one skeleton found in a volcanic breccia in Central France; the other is a pelvic bone from Natchez, Mississippi. It is very difficult to ascertain the precise age of volcanic deposits; but in the Denise case the labor is relieved by the discovery of the bones of a hyena and a hippopotamus in the same layer; and in a lower layer are the bones of the *Elephas meridionalis*, belonging to the Pliocene. The association has certainly a Post Pliocene character. The human skull is of the ordinary Caucasian type. The Natchez specimen does not need much consideration. It was found in the bottom of a ravine, in company with bones of the mastodon and the megalonyx, all of which had been worn out of the banks of the ravine, but undoubtedly from different layers, — the extinct animals from below, and the human bone from a grave above. Such was Lyell's opinion in 1846, though he is disposed to think more favorably of the contrary supposition at present.

Four chapters of the book are devoted to a description of the relics of man found in alluvial gravel. The most noted example is the valley of the river Somme, in the North of France. The principal sites of the " diggings " are at Abbeville, Amiens, and St. Acheul. The river empties into the English Channel, after passing in a northwest direction through Picardy. Abbeville is about twelve miles from the sea, and Amiens is twenty-five miles farther up the valley. St. Acheul is three or four miles below Amiens. The valley is excavated out of chalk, and between Abbeville and Amiens averages about a mile in width, the average depth of the chalk being from two to three hundred feet. The bottom of the valley, from its debouchure to a point far above Amiens, is occupied by beds of peat; and were thirty feet thickness of this vegetable deposit now removed, the sea would flow up, filling the valley for miles above Abbeville. The twenty or thirty feet of peat at Abbeville are underlaid by gravel, probably the same as that upon the sides of the valley bordering the peat, containing elephants' bones and flint tools, and overlaid by loam, thus forming a terrace. Above this terrace is a second, upon both sides of the valley, similarly constructed, and holding the same kinds of fossils. The sum of the thickness of the two beds of gravel is from fifty to seventy feet. The remains found at St. Acheul are also in a terrace, whose top is one hundred feet above the Somme, and a hundred and fifty feet above the sea. Lyell observes — and it is in accordance with the inductions of American geologists — that the higher terraces and banks of gravel, which are also more remote from the bottom of the valley, are the most ancient. There does not seem to be any of the unmodified or older coarse drift in the valley of the Somme, although it appears that ice abounded in the valley to a considerable extent during the stone period; especially forming during the winter a thick coating of river ice, in which the natives may have dug holes for fishing and other purposes. The climate must have been much colder then than it is now.

Lyell regards the peat of the valley of the Somme as belonging to the Recent Period. It has yielded works of art of the iron and stone periods, besides the remains of a few living animals and three human skeletons. No succession of different kinds of trees has yet been discovered, as in Denmark. The depth at which articles of Roman manufacture have been found is considerable; but no satisfactory attempt is made to estimate the number of years occupied in the growth of the whole. The country now seems to be sinking, since the peat underlies the sand dunes of the coast. Several kinds of flint implements occur in the older gravel, whose manufacture exhibits different degrees of skill. The most imperfect are fragments of the chalk-flints very slightly fashioned. Then come the "knives," which are little more than chips of flint rudely shaped. Next are arrow-heads and oval spear-heads. The edges appear to have been fashioned by chipping, not by grinding, as in the case of the existing Australian stone weapons. They are rather like the stone tools of the North American Indians, used as weapons of war and chase, as well as to grub up roots, cut down trees, scoop out canoes, and cut holes in the ice. It is estimated that more than one thousand of the more perfect stone implements have been dug out of the gravel in the valley of the Somme since 1842.

The gravel-pits at Abbeville have brought to light a great variety of fossils. In the lower layers are found land shells, fresh-water shells, marine shells, bones of the rhinoceros, elephant, and other mammals, and flint tools, — a very singular combination of fluvio-marine relics. The shells correspond perfectly with those of the mollusks now frequenting France and Scandinavia, except one, the *Cyrena fluminalis*, which no longer lives in Europe, but inhabits the Nile and many parts of Asia. The occurrence of this shell would indicate a warmer rather than a colder climate in the stone age, if it decides anything. The fossil mammals are the elephant, woolly rhinoceros, horse, *Bos primigenius*, an extinct deer, reindeer, cave-lion, and hyena, only one of all which species still survives.

No mention is made of the remains of any other living mammal, although it is regretted that the fauna has not been carefully investigated.

At St. Acheul, near Amiens, no marine remains occur, but the flint implements and fossil bones abound. Two species of elephant and a hippopotamus have left their remains here. It is in the terrace containing these relics that evidence of the former presence of ice has been found. The deposit is stratified with great blocks of sandstone scattered through it, too large and angular to have been transported by water simply. The ledges from which they may have been derived are situated at the head of the valley of the Somme, and also above the cliffs of chalk on the sides of the valley. No fragments of rock foreign to the valley have been detected in any of the gravels. Various contortions in the stratification are ascribed to the agency of ground ice. The great multitude of flint tools in the gravel is an argument for supposing that ice covered the river during long winters. Many of them would naturally have been lost in the fishing-holes, or dropped upon the surface in the snow, or, if manufactured during the inactive cold period, they might have been accumulated in large numbers. The evidence of ice is not detected in the very lowest layer, or that containing the *Cyrena fluminalis*. Not a single human bone had been found in the gravel of this valley when the description was written.

Lyell also describes flint tools found with the remains of extinct animals in other river-valleys in France and England. In the valley of the Seine stone implements occur at several localities, and in one case the lower jaw of a man, both associated with elephantine relics. In the valley of the Oise, with flint implements and elephants' bones, occur the remains of the musk-ox, now living only in the Arctic Zone. In the gravel deposits of the Thames are found the same assemblage of marine, terrestrial, and fresh-water animals as on the Somme, including the Cyrena. It is suggested that the colder and warmer faunæ met in this valley. Several examples of the discovery of flints are recorded in the Thames valley, but their geological position has not been determined with accuracy. In the valley of the Ouse, near Bedford, are beds of gravel from which the associated remains of the elephant, deer, and ox, fresh-water shells, and flint weapons were obtained. Clear evidence is here afforded that the gravel was deposited subsequently to the coarse drift. Other similar examples are mentioned in Suffolk.

Since the issue of "The Antiquity of Man," a human jaw has been discovered in the gravel near Abbeville. A conference respecting it was held in Paris, consisting of five English and five French *savants*. Three days were occupied in discussing the question of the flint implements, or *haches*, and in the examination of the jaw. No decisive result was obtained. The English members of the Commission maintained the unauthentic character of all the *haches* which were yielded by the "black band," and nothing was established on the other side to shake their convictions. The jaw was sawed up and washed; there was no infiltration of metallic matter through the walls of the bone, and the section was comparatively fresh-looking. The tooth was also very fresh. The confidence of some of the French members of the Commission was seriously shaken by the characters yielded by the jaw, while, so far as internal evidence went, it was wanting in every appearance which commonly distinguishes fossil bones, and especially those found elsewhere in the Somme deposits. The conference adjourned to Abbeville. Here *haches* were disengaged from one of the gravel-pits, under the very eyes of the Commission, and direct testimony to the actual occurrence of the jaw in the black band was brought forward to their satisfaction. But they disagreed as to the age of the jaw itself. Two of the English members gave their opinion that the jaw could not be of great antiquity; that the "internal condition of the bone is wholly irreconcilable with an antiquity equal to that assigned to the deposits in which it was found." It came from the higher deposits, which are the oldest of all the Somme beds. At a meeting of the Academy of Sciences, held subsequently, the French members of the Commission reported the results of their proceedings, and did ample justice to the candor and frankness of their English opponents. During the proceedings, the veteran geologist, M. Elie de Beaumont, stated that, in his opinion, this gravel deposit did not belong to the Quaternary or Diluvian age at all, but that it was a member of the *terrains meubles* of the *actual* or *modern* period, in which he would not be in the least surprised if human bones were found; adding, moreover, that he did not believe in the asserted existence of man as a contemporary of the extinct elephants.

We will not comment upon the worth of the evidence drawn from the alluvial gravels for the contemporaneity of man with the extinct elephants, since those who have carefully examined the deposits in person arrive at widely divergent conclusions, and upon this side of the Atlantic we can only follow opinions without examination of the phenomena. Should it be ultimately proved that Lyell and others are in gross error, it would not be an anomaly in geological science. Geologists can refer to important changes of views on subjects equally intricate with this, within the past decade. At the outset of the discovery of important phenomena, theories vary from one extreme to another, and it is only after years of toil and discussion that the golden mean of truth is attained, and the extreme views become modified.

In only one other variety of deposit have human remains been found, and that is in the *loess* of the Rhine. Lyell supposes that the Glaciers of the Alps formerly extended much farther north than their present limits, and that the impalpable powder washed from the moraines was carried onward by currents, and finally deposited in still water. It is a fine, black mud, like that of the Nile, Ganges, and Mississippi, deposited so continuously that no stratification is apparent. Land shells are often found in it. The *loess* of the Rhine extends nearly to its mouth. It varies from ten to thirty feet in thickness, and near Brussels caps some of the hills at the elevation of three hundred feet above the ocean. The elephant and the rhinoceros are characteristic of the *loess* throughout the whole basin. It is generally underlaid by gravel. Oscillations of level are required to explain the accumulation and denudation of this silt.

It is on the banks of the Meuse, a tributary of the Rhine, at Maestricht, that a human lower-jaw with teeth was found about the year 1820. It was taken from an excavation sixty feet deep, made for a canal, the lower forty feet of the bank consisting of gravel. The jaw was found one foot above the gravel, six yards distant horizontally from an elephant's tusk. Other bones obtained from nearly the same layer in this excavation were those of the elephant, deer, and ox; still others were found in the gravel, and a very few in the higher part of the loam. This is the only known example of an ancient human bone found in the *loess*.

Six chapters of "The Antiquity of Man" relate very remotely to the subject indicated by the title, and need not be here discussed, although very interesting, since they concern the glacial or drift period, a time confessedly long anterior to the date of the earliest flint implement fashioned by the hand of man. In them are described some new phases of drift action, the relation of the drift to the later tertiary deposits, and the special action of the glaciers in different countries, as Scotland, Scandinavia, Wales, England, Switzerland, Italy, and North America. It is an excellent source from which to derive the latest opinions entertained by an eminent philosopher respecting the phenomena of surface geology. Among other things, he shows that all glacial deposits are not of the same age, since glaciers have been at work in some country from the dawn of the Post Pliocene to the present day. The same fact had been previously stated by one or more American geologists, and it is an important item to be remembered in the continuance of the investigation of the antiquity of man.

The five concluding chapters, relating to the hypothesis of the origin of species by transmutation, deserve brief consideration. The following is the application of the hypothesis to the human fossils. Man was derived from the apes. He was not created directly by the Deity out of the dust of the earth. But the change of structure must have been very gradual from one class of these beings to the other, and therefore the transmutationist looks to the very earliest relics of the structure of man in the vain expectation of finding greater and greater approximation to the apes. If the inquirer should succeed in discovering such relics, the hypothesis might place itself in a defensive attitude. Lyell is one of those philosophers who are determined to devise theories for the explanation of every phenomenon in the mental and physical world without reference to the creating and controlling hand of the Deity. He says, "Independent creation, as it is often termed, or the direct intervention of the Supreme Cause, must simply be considered as an avowal that we deem the question to lie beyond the domain of science." We differ *in toto* from the author on this point. We believe that the intervention of the Supreme Cause is the first article of a true philosopher's creed, and that the expression of Scripture, "If any man will do his will, he shall know of the doctrine," applies to scientific as well as religious truth; while those who do not humbly apply to the Divine source for illumination may be left to grope their own way by the light of their own enfeebled reason, and thus be led into the mazes of error.

Lyell, in his treatment of this hypothesis, first reviews the history of the different views of the origin of species; namely, of Lamarck's development theory, Darwin's transmutation theory, and the more common progression theory. He tells us why he formerly opposed Lamarck's views, and why he now thinks well of Darwin's conclusions. Then he endeavors to answer several general and specific objections to the transmutation of species, not as a systematic defence, but an incidental help. The question of the origin of languages occupies a separate chapter, in which he draws a minute comparison between the variations of dialects and languages and the variations of species, and very illogically derives an argument for the origin of species by selection from the origin of dialects by means of human selection, thus confounding together mental and physical laws. Last of all, he applies the hypothesis of transmutation to man, not exactly indorsing the hideous doctrines involved in it, but showing more care to argue in favor of the development views than against them. None of the strong points against transmutation are presented, so that one cannot avoid the impression that the author leans towards the view that man is a lineal descendant from the apes, and has derived all his mental and spiritual powers, by purely natural processes, from whatever of intellectuality and spirituality exists in a latent form in the brutes. The grand organ by which this improvement is supposed to be effected, is the power of speech. Man can thus transmit his experience to his fellows, and every generation can improve upon the preceding.

The fallacy of the attempt to derive man from the apes may be seen by examining the zoölogical distinctions between them recently so clearly set forth by Professor Dana, and we need offer no other argument against transmution; for if the hypothesis fails in the most essential link, the whole structure is destroyed. We have already quoted from Huxley the admission that no fossil human remains yet found depart widely from the Caucasian type, and that for at least ten thousand years, according to Lyell's calculation, so that the species can but be regarded as permanent, on their own reckoning.

In the classification of the Animal Kingdom, we have first the five grand types, then the classes, and, thirdly, the orders. Classes are characterized by the manner in which the plan of the structure of the respective types is executed, and orders are characterized by the degrees of the complication of the class structure. The differences between man and the gorilla — the most perfect ape — are those of *degree.* Consequently man constitutes by himself a distinct zoölogical order, called *Bimana* (Blumenbach), *Archencephala* (Owen), or *Archont* (Dana). Now, if man belongs to a distinct order from the apes, you cannot transform one into the other short of a score of gradations, which are entirely wanting in nature. The ape has four feet resembling hands; man has two hands and two feet. Man is the sole animal that uses only two extremities for locomotion, — birds not excepted, because their forward extremities, being changed to wings, are used for a higher degree of locomotion. Man's anterior extremities have been transferred from the locomotive to the *cephalic* series; that is, are made to attend to the wants of the head exclusively, and not to assist in locomotion also, as in the apes. Man's hands supply the cravings of appetite, and execute the desires of the mind, — the latter wants never being attained by the brutes. The anterior extremities of the apes assist in locomotion, not one of them walking erect naturally. And the erect posture of man is the natural effect of his superior physical structure. Now this *cephalization*, this subordination of the members and structure of the anterior part of the body to the head, is a difference in degree, constituting an order.

Dana has recently shown, in several articles, that the same cephalic distinctions exist throughout the animal kingdom, have actually been made the basis of classification in certain classes, and should be of the whole. Take the class of *Crustacea*, or crabs, for an example, which embraces three orders. In the highest order, the *Decapods*, such as the common crabs and lobsters, there are *five* pairs of feet and *six* pairs of mouth organs. In the next order, *Tetradecapods*, the fourteen-footed species, such as small cetacean parasites, there are *seven* pairs of feet and *four* pairs of mouth organs. The second division has therefore gained two pairs of feet, and the mouth has lost two of the organs which, in the animals of the first order, served to supply it with food, or, in other words, two pairs have passed from the cephalic to the locomotive series. In the lowest order, the *Entomostracans*, the mouth organs are even less numerous than in the second. There are several other elements to be taken into account in ascertaining the exact place of each order in every class; but we have presented enough to illustrate the principle of cephalization, and to show the error of those who refer man to the same order with the apes. Professor Dana deserves the gratitude of philosophers for the skill with which he has originated and developed this grand criterion of degree in classification.

We cannot better close our article than by adverting to the conclusions which seem to flow naturally from this discussion.

1. *It is extremely probable that the entire existing faunas and floras, including man, were introduced in the latter part of the Post Pliocene period.* The greater part of the earlier Post Pliocene group continued to exist while a number of new species were introduced. It is a great error to infer that man has existed for a very long period because he and his associates were contemporaneous with the mastodon. The earlier species continued to exist a long time after man's entrance upon the stage, and are not yet entirely extinct. Let us look at a few examples. Ninety-five per cent or more of the Post Pliocene mollusks are still living. The following are some of the living mammalian contemporaries of the hyena and rhinoceros: the red deer, roe, reindeer, aurochs, wild-cat, bear, wild boar, wolf, fox, weasel, beaver, hare, rabbit, hedgehog, mole,

dormouse, field-mouse, water-rat, shrew. On the other hand, many Post Pliocene animals have become extinct within the time of written history. Sixteen species of birds have recently become extinct, and another, the great auk (*Alca impennis*), has not been seen alive within the present century, although its remains are exceedingly abundant in some alluvial deposits. The Dodo and Solitaire of Mauritius were alive two hundred years ago. Eleven species of Dinornis, the Notornis and Apteryx of New Zealand, and the Æpiornis of Madagascar, have also passed away recently, chiefly, perhaps, by the hand of man. The large *Sirenia Rhytina* is not now found living, and the Arctic musk-ox is on the point of extinction. The *Bos primigenius* existed till the time of Julius Cæsar. The great Irish stag probably lived much longer than many of his earlier contemporaries. The aurochs would have become extinct long ago, did not legal enactments preserve a few in a forest in Lithuania. One of the mammoths was introduced in the Newer Pliocene, and lived to be contemporary with man for a time.

The question has arisen in some minds, whether the human contemporaries of the mammoth were different from the living races. No great peculiarities have been detected in their bones, but it is certain they must have been an uncivilized and barbarous race, and hence may have deteriorated for a time, like all savage tribes. Some authors think that the human contemporaries of the mammoth may have belonged to a different species from the living races. If it can be proved that the Post Pliocene period terminated with the introduction of the now living species, this would be a plausible theory, removing all difficulties; and we may have Scriptural hints of it in references to beings "which kept not their first estate," who had evidently sojourned for a time in some terrestrial abode. Should this view ever be extensively adopted, many interesting speculations may be originated respecting the duration, history, and extinction of these primeval inhabitants of the globe.

But we have in our country a few glimpses of the late history of the mastodon, sufficient to suggest his existence within a comparatively brief period. One of the finest specimens of the bones of this animal ever exhumed were dug out of a peat-bog in Newburg, N. Y., in 1845, and are now exhibited in

Dr. Warren's collection in Boston. The bones were remarkably fresh when found, and even the masticated twigs of which his last meal was composed were preserved in the interior. The animal had become mired in a bog, doubtless when in quest of his favorite food. His immense weight caused him to sink so deep in the marl and peat that extrication was impossible. The bones rested chiefly in a marl bed, like those which are forming every day. Above this was a bed of peat about three feet thick. We have no means of knowing the rate of growth of peat in this country; but by assuming a rate rejected by Lyell as too small for the valley of the Somme, a brief calculation shows that three or four thousand years would be a sufficient time for its growth; and this would seem to be an exaggeration. It would not be strange, indeed, if the gigantic animal had become mired some time after the peat had begun to form, and had sunk entirely through the higher stratum. The account of the mastodon found in Gasconade County, Missouri, has an air of probability attached to it. The animal had apparently become mired in a swamp, and was then killed by the Indians with stones and weapons, and a fire kindled over his body. A large number of stones, from two to twenty-five pounds each in weight, had been brought together from a distance of several hundred yards, "evidently thrown with the intention of hitting some object." Intermixed with burned wood and burned bones were broken spears, axes, and knives of stone. The fire seemed to have been greatest upon the head and neck. Even fragments of what appeared to be the skin were found among the rocks. The Indians have traditions of the appearance of an immense animal in the Ohio country, which Thomas Jefferson, the discoverer of the megalonyx in this country, refers to the mastodon, in his "Notes on Virginia." The South American Indians, too, have their traditions of a giant bear called the naked bear, and another animal wonderfully like the Jeffersonian megalonyx. Other North American legends speak of the great elk or buffalo, which, besides enormous horns (tusks), had an arm protruding from its shoulder, with a hand at its extremity (proboscis). Lyell, in speaking of extinct quadrupeds of this country, in his "Second Visit to the United States," says, "That they were exterminated by the arrows of the Indian hunter is the first idea presented to the mind of almost every naturalist."

Within a hundred years the entire carcasses of an elephant and a rhinoceros have been dug out of the frozen mud of Siberia. The former was protected from the cold by an abundance of long hair. Its flesh was eaten by dogs when discovered. The impression derived from all these examples is certainly, that some of these gigantic animals have lived almost to our time, although the facts known to us are not sufficient to authorize us to believe in the proposition as demonstrated. This branch of the subject has not received the attention it deserves.

2. *The epoch of the Noachian Deluge may have terminated the Post Pliocene age.* Groups of animals may become extinct in any of the following ways: by a change of level, either a depression or elevation; by variation of temperature by means of volcanic eruptions or climatic changes; or perhaps by the gradual dying out of a species for the want of vital energy. These causes, when acting with sufficient intensity to produce extermination, are called *catastrophes*. The extermination may be partial or entire. Now, if it can be shown that at the time of the deluge there were great changes in elevation, in climate, or in the level of water, we have evidence of the existence of agencies sufficient to produce a catastrophe, and may ascribe to it the disappearance of so many of the Post Pliocene animals. There are no marks of physical change upon the earth which the geologist can unhesitatingly refer to the agency of the Noachian deluge. So temporary was its continuance, that we must rely upon human testimony as the sole proof of its occurrence.

Upon the supposition that the epoch of the Deluge marks the conclusion of the Post Pliocene period, we will bring together in parallel columns the chronology of man in years, according to written records and the geological classifications of the most recent periods, placing in the same line all synchronous epochs. We use the classifications of Lyell, Hitchcock, and Guyot. Another column will show the percentage of living species of molluscous animals found in several of the periods. The table will illustrate the relations of the events much better than many paragraphs of explanation. It enumerates all the periods of Cenozoic time, which is the latest of the three great periods of life upon the earth, and the age of mammals. Not a relic of a single living animal has been taken from any deposit earlier than the Eocene.

| | Lyell. | Lyell. | Hitchcock. | Guyot's classification for Switzerland. | Human Periods. | Chronology. | Per cent. of living mollusks. |
|---|---|---|---|---|---|---|---|
| CENOZOIC. | EOCENE. | Lower Eocene.<br>Middle Eocene.<br>Upper Eocene. | | | | Many thousand years. | 2 to 3. |
| | MIOCENE. | Lower Miocene.<br>Upper Miocene. | | | | | 15–20. |
| | PLIOCENE. | Older Pliocene. | | | | | 40–50. |
| | | Newer Pliocene. | | | | | 70–90. |
| | POST TERTIARY. | Post Pliocene. | Drift period. | Northern Glacial epoch. | | | |
| | | | Beach period. | Epoch of subsidence. | | | |
| | | | Terrace and Champlain period. | Ancient diluvium, Glacial deposits and Loess. | Stone age. | A. M. 1–1656. | 90–95. |
| | | | | | NOACHIAN DELUGE. | | |
| | | Recent period. | Historic period. | | Later stone age.<br>Bronze age.<br>Iron age. | 1656 to 5867. | 100. |

It is worthy of note that the times of the stone, bronze, and iron ages of different nations do not synchronize. The Papuans, and some of the North American Indians, have not yet passed through their stone age. Others, like the Greeks and Romans, entered upon the age of iron very early in their history. Hence the length of any age in one country is no criterion for the duration of the corresponding period in another. The most trustworthy source of information upon questions of chronology is human history, whether monumental or written. One can thus determine the length of the respective stone, bronze, and iron ages in most European, many Asiatic, some African, and most American countries. A little archæological research would develop many interesting details of early national history.

3. *The geological mode of calculation by years is not very authentic.* An instance of its imperfection by the side of the Egyptian records has already been noticed. There are too many variable quantities in all geological calculations, whose exact limits cannot be accurately determined. Although it is not commonly understood, geologists are aware that Sir Charles

Lyell's reasonings upon the antiquity of man are based upon a fallacious theory; and that his reputation as a geologist has been acquired largely by the ability with which he has defended his favorite views. His "Principles of Geology," an octavo of more than eight hundred pages of small print, is chiefly a defence of this "uniformitarian theory." Grant the truth of the theory, his conclusions respecting the great antiquity of man inevitably follow. Establish the soundness of the doctrine of a diversity in the intenseness with which geological agencies have operated during the past history of the earth, and you have destroyed the ground of his conclusions, and rendered the reduction of geological periods into solar years a matter of extreme difficulty. Understanding, therefore, the ground of Lyell's conclusions, we need not be so easily led away by the plausible nature of his arguments.

One of the assumptions upon which the reasoning in "The Antiquity of Man" is based is, that the rate with which changes are now going on in the earth's crust must be taken for our standard of estimate for all the ancient life periods. Another assumption is, that a great length of time has intervened between the formation of the strata pertaining to each successive period, and that the changes of life have not been sudden, but that the old species have gradually died out, one by one, to be exchanged for new forms at the same rate.

To these uniformitarian views we object, first, because they depreciate the very basis and standard of calculation, namely, the thickness of deposit. They really suppose more variety than the contrary view, by inserting indefinite periods of repose between periods of activity.

We object to these views, secondly, because we have no evidence of the gradual introduction of new species as fast as old species disappear. Examples of the extinction of thirty-seven species of birds and mammals in the Recent Period have been mentioned. Where are the new forms that have been subsequently introduced to take their places?

We object to these uniformitarian views, thirdly, because the agencies acting with variable intensity are too numerous to admit of accurate calculation on the ground of uniform operation. Had we the means of knowing the exact amount of variation in every case, the calculation would be easy. The following are examples of the variable quantities. The calculation of time from the succession of forests depends upon a diversity of circumstances, as the character of the soil, liability to destruction from fire, the rate at which different kinds of trees spread themselves by seed, and the degree of competition among different species. The time calculated in one case would be fourfold that of another. The rate of the growth of peat depends upon the amount of moisture present from the atmosphere and in the soil. A deposit in one degree of latitude may increase twice as fast as one in the next parallel. The rate of accumulation of alluvial deposits is very variable. Those who have observed the accumulations in alluvial valleys very well know that in one year a sand deposit may be ten times as great as in any other year; and that the times of abundant and meagre deposits are regulated by no known law. Another variable is the rate and continuance for ages of a change in the comparative levels of land and water, than which no cause exerts a greater influence in accumulating detritus, whether in large or small quantity; and we may also say, that no other agency acts so capriciously. Another disturbing element in the calculation of geological time is the climate. Abrading agencies act with greater intensity in cold than warm climates, and Lyell's researches go to show a later extension of a sub-arctic climate in the Northern regions than has been commonly supposed. Other variables might be adduced; but we have certainly specified a sufficient number of examples to satisfy any one that the basis of calculation of solar years upon geological data is not to be confided in. Nor can the average amount of possible variations be assumed as the correct sum, since we are uncertain whether the disturbing agencies have or have not operated; and hence the average may be too great or too small. No questions are so often put to the geologist by the community as chronological questions like these: How many years is it since the Connecticut birds left their tracks in the mud? How long is it since the mammoth flourished? And few questions can be so unsatisfactorily answered. The geologist calculates by periods, not by years. His part is to decide upon the synchronism of organic beings; for example, whether the Connecticut birds were contemporary with the Saurians of the Jurassic or the Labyrinthodonts of the Triassic series; while he would reply to the first question, that the birds existed so many *periods* previously to the historic era.

4. *Man did not appear upon the globe until a very late epoch of the Alluvial period, and geology cannot point out a single example of an animal introduced later than man.* It was fitting that the monarch of the animal kingdom should be introduced into a world whose valleys, plains, and rivers had been already inhabited by successive economies of life, yet all inferior to himself. Many excellent men have been troubled by the apparent collisions between science and the Bible; but so long as the conclusions of geology are as harmonious with the sacred record of the creation as in the present instance, they need not fear. The Pentateuch represents man as the latest born of organisms, so does geology; but the Pentateuch does not say that the Post Pliocene animals all became extinct before his creation, as many authors seem to have inferred.

ART. IX. — *A Treatise on Hygiene, with special Reference to the Military Service.* By WILLIAM A. HAMMOND, M. D., Surgeon-General U. S. Army. Philadelphia: J. B. Lippincott & Co. 1863. 8vo. pp. 596.

WHEN some future historian shall narrate the cruel tale of the great civil war in America, among the scenes of horror and suffering which always go to make up that "sum of all evils" there will be found to soften his theme many incidents, not only of heroism and patriotism, but also of humanity advanced, of the welfare of the sick and wounded promoted, and of knowledge in the sacred art of healing enlarged. The reviewer of these fields will see, not only battles and slaughter, imprisonment and want, but the divine offices of benevolence performed by hundreds of self-sacrificing men of all ages; the sick and wounded tended in gigantic hospitals, where modern